

Memo

Date: Friday, December 21, 2018

Project: WDFW Pioneer Park Hatchery NPDES Support

To: Leanne Weiss (Ecology) and Miranda Hodgkiss (USEPA)

From: Ray Berg (WDFW) and Chad Wiseman (HDR)

Subject: PPH Monthly Nutrient and BOD Loading

Introduction

On an April 16, 2018, the Washington State Department of Ecology (Ecology) requested that the Washington Department of Fish and Wildlife (WDFW) provide monthly pollutant load estimates for the proposed Pioneer Park Hatchery (PPH) for use in development of the Budd Inlet total maximum daily load (TMDL) and Water Quality Improvement Report/Implementation Plan (WQIR/IP). Also, the USEPA is revising Ecology's Deschutes River TMDL and WQIR/IP, as it relates to dissolved oxygen and pH, and Ecology. Ecology recommended that the WDFW provide monthly pollutant load estimates to the USEPA for consideration in their revision. This technical memorandum presents those aforementioned pollutant load estimates.

Methods and Results

Currently Proposed PPH Operations

The current PPH proposal is for the WDFW to only hatch and rear sub-yearling Chinook salmon. This program will require feeding from January – June 15 (Table 1). After June 15, all juvenile Chinook will have volitionally exited the PPH facility. The PPH will not operate from June 15 – August 30, and will have zero discharge. Chinook salmon adults return to the Tumwater Falls facility in August and September. The PPH will be used for egg incubation from those adults from September – December. No feed will be fed during those months, but there will be a relatively small discharge associated with the egg incubation (Table 1).

During the January – June 15 rearing period, there will be solids, nutrients, and BOD discharged to the Deschutes River (Table 1). These pollutant loads are associated with feeding and rearing waste. The following methods and operational assumptions were used to estimate the pollutant loads:

- Solids, nutrient, and biological oxygen demand (BOD) loadings were estimated using published factors (i.e. ratios) of pollutants produced per pounds fed (Castledine 1986; Piper et al. 1982). Organic and inorganic phosphorus ratios were modified to account for the low phosphorus feed proposed for use at the PPH.
- 80% of solids and organic N and P are assumed to be vacuumed and treated at the pollution abatement pond (PA Pond). The remaining 20% of solids and organic N and P are assumed to discharge to the Deschutes River.

- All dissolved phosphorus, nitrate + nitrite, and ammonia generated from feeding and rearing are assumed to be discharged to the Deschutes River.
- Pollutant removal rates in the PA Pond were assumed to be 85% for suspended solids, 30% for organic phosphorus, and 60% for organic nitrogen and BOD.
- Nutrients from well water is assumed to be a new source to the Deschutes River. All dissolved phosphorus, nitrate + nitrite, and ammonia generated from well water are assumed to be discharged to the Deschutes River
- Calculations are provided in Attachment A.

The PPH will not operate from June 15 – August 30, and will have zero discharge (Table 1). From September – December, there will be a relatively small discharge associated with the egg incubation (Table 1). No solids, organic nutrient or BOD pollutant loading will occur during egg incubation. However, since groundwater will be used during egg incubation, and the groundwater is considered a new source, the dissolved nutrients from the source groundwater is counted in the load calculation.

Future Potential PPH Operations

In the future, the PPH will seek to expand operations to include hatching and rearing of sub-yearling Chinook salmon, yearling Chinook salmon, coho salmon, and steelhead. This program will require year-round feeding, with fish poundage and feed peaking in May – June 15 (Table 2). Most fish poundage and feed are associated with sub-yearling Chinook salmon feeding. After June 15, all sub-yearling Chinook will have volitionally exited the PPH facility, leaving yearling Chinook Salmon, coho salmon and/ or steelhead. Chinook salmon adults return to the Tumwater Falls facility in August and September. Chinook salmon egg incubation from those adults will occur from September – December.

There will be solids, nutrients, and BOD discharged to the Deschutes River (Table 2). These pollutant loads are associated with feeding and rearing waste and groundwater. The methods described in the previous section (Currently Proposed PPH Operations) were used to calculate pollutant loads. Calculations are provided in Attachment A.

Table 1. Currently proposed PPH water use, bioprogram, and pollutant load estimates for solids, nutrients, and BOD.

Parameter	January	February	March	April	May 1 - June 15	June 15 - 30	July	August	September	October	November	December
Fish and Feed Quantities						Zero Discharge						
Pounds of Fish	3,800	6,333	12,000	20,000	42,857		0	0	0	0		
Pounds of Feed	1,580	3,400	4,800	6,850	13,700		0	0	0	0		
Source Water Use												
Deschutes River (gpm)	4,230	5,640	8,460	8,460	9,400		300	300	300	300		
Water Well (gpm)	0	0	0	0	0		500	500	500	500		
Total Water (gpm)	4,230	5,640	8,460	8,460	9,400		800	800	800	800		
Total Water (cfs)	9.4	12.6	18.8	18.8	20.9		1.8	1.8	1.8	1.8		
TSS and Nutrient Loading												
Total Suspended Solids (lbs/day)	5.06	10.88	15.36	21.92	43.84		0	0	0	0		
Organic Phosphorus (lbs/day)	0.14	0.31	0.44	0.62	1.25		0	0	0	0		
Inorganic Phosphorus (lbs/day)	0.07	0.16	0.22	0.32	0.64		1.31	1.31	1.31	1.31		
Organic Nitrogen (lbs/day)	0.18	0.38	0.53	0.76	1.52		0	0	0	0		
Nitrate + Nitrite (lbs/day)	1.67	3.59	5.07	7.24	14.48		0.30	0.30	0.30	0.30		
Ammonia (lbs/day)	2.02	4.34	6.13	8.75	17.49		6.55	6.55	6.55	6.55		
BOD (lbs/day)	9.31	20.04	28.29	40.38	80.75		0	0	0	0		

Table 2. Future potential PPH water use, bioprogram, and pollutant load estimates for solids, nutrients, and BOD.

Parameter	January	February	March	April	May	June	July	August	September	October	November	December
Fish and Feed Quantities												
Pounds of Fish	4,000	6,675	16,017	26,698	57,310	4,250	5,500	7,500	9,250	11,667	13,611	16,111
Pounds of Feed	1,660	3,690	5,940	9,130	9,390	875	1,393	1,223	1,690	1,360	1,750	2,925
Source Water Use												
Deschutes River (gpm)	9,008	9,429	9,429	9,429	9,000	9,000	850	850	850	1,350	1,350	1,350
Water Well (gpm)	156	500	500	500	0	0	500	500	500	500	500	500
Total Water (gpm)	9,164	9,929	9,929	9,929	9,000	9,000	1,350	1,350	1,350	1,850	1,850	1,850
Total Water (cfs)	20.4	22.1	22.1	22.1	20.0	20.0	3.0	3.0	3.0	4.1	4.1	4.1
TSS and Nutrient Loading												
Total Suspended Solids (lbs/day)	5.31	11.81	19.01	29.22	30.05	2.80	4.46	3.91	5.41	4.35	5.60	9.36
Organic Phosphorus (lbs/day)	0.15	0.34	0.54	0.83	0.86	0.08	0.13	0.11	0.15	0.12	0.16	0.27
Inorganic Phosphorus (lbs/day)	0.49	1.48	1.58	1.73	0.44	0.04	1.37	1.36	1.39	1.37	1.39	1.44
Organic Nitrogen (lbs/day)	0.18	0.41	0.66	1.01	1.04	0.10	0.15	0.14	0.19	0.15	0.19	0.32
Nitrate + Nitrite (lbs/day)	1.85	4.20	6.58	9.95	9.92	0.92	1.77	1.59	2.09	1.74	2.15	3.39
Ammonia (lbs/day)	4.16	11.26	14.13	18.21	11.99	1.12	8.33	8.11	8.71	8.29	8.78	10.28
BOD (lbs/day)	9.78	21.75	35.01	53.81	55.35	5.16	8.21	7.21	9.96	8.02	10.32	17.24

Attachment A
Feed Rate Calculations

Table A-1. Solids and nutrient pollutant load calculations per Castledine (1986) for currently proposed PPH operations.

	Parameter	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Ratio of Pollutant per Feed	Monthly Waste Pre-Treatment (lbs.)	Daily Waste Pre-Treatment (lbs.)	Groundwater Flowthrough (lbs.)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent (lbs.)	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Effluent (lbs.)
January	Settleable and Total Suspended Solids (TSS)	4,230	1,580	0.3	474	15.80	0.00	3.16	12.64	10.74	1.90	5.06
	Settleable and Suspended Phosphorous (Organic Phos)	4,230	1,580	0.0036	6	0.19	0.00	0.04	0.15	0.05	0.11	0.14
	Dissolved Phosphorous (inorganic Phos)	4,230	1,580	0.0014	2.21	0.07	0.00	0.07	0.00	0.00	0.00	0.07
	Settleable and Suspended Nitrogen (Organic Nitrogen)	4,230	1,580	0.0064	10	0.34	0.00	0.07	0.27	0.16	0.11	0.18
	Dissolved Nitrogen (Nitrate + Nitrite)	4,230	1,580	0.0317	50	1.67	0.00	1.67	0.00	0.00	0.00	1.67
Ammonia	4,230	1,580	0.0383	61	2.02	0.00	2.01	0.00	0.00	0.00	2.02	
February	Settleable and Total Suspended Solids (TSS)	5,640	3,400	0.3	1,020	34.00	0.00	6.80	27.20	23.12	4.08	10.88
	Settleable and Suspended Phosphorous (Organic Phos)	5,640	3,400	0.0036	12	0.41	0.00	0.08	0.33	0.10	0.23	0.31
	Dissolved Phosphorous (inorganic Phos)	5,640	3,400	0.0014	4.76	0.16	0.00	0.16	0.00	0.00	0.00	0.16
	Settleable and Suspended Nitrogen (Organic Nitrogen)	5,640	3,400	0.0064	22	0.73	0.00	0.15	0.58	0.35	0.23	0.38
	Dissolved Nitrogen (Nitrate + Nitrite)	5,640	3,400	0.0317	108	3.59	0.00	3.59	0.01	0.00	0.01	3.59
Ammonia	5,640	3,400	0.0383	130	4.34	0.00	4.33	0.01	0.00	0.01	4.34	
March	Settleable and Total Suspended Solids (TSS)	8,460	4,800	0.3	1,440	48.0	0.00	9.60	38.40	32.64	5.76	15.36
	Settleable and Suspended Phosphorous (Organic Phos)	8,460	4,800	0.0036	17	0.6	0.00	0.12	0.46	0.14	0.32	0.44
	Dissolved Phosphorous (inorganic Phos)	8,460	4,800	0.0014	6.72	0.2	0.00	0.22	0.00	0.00	0.00	0.22
	Settleable and Suspended Nitrogen (Organic Nitrogen)	8,460	4,800	0.0064	31	1.0	0.00	0.20	0.82	0.49	0.33	0.53
	Dissolved Nitrogen (Nitrate + Nitrite)	8,460	4,800	0.0317	152	5.1	0.00	5.07	0.00	0.00	0.00	5.07
Ammonia	8,460	4,800	0.0383	184	6.1	0.00	6.12	0.01	0.00	0.01	6.13	
April	Settleable and Total Suspended Solids (TSS)	8,460	6,850	0.3	2,055	68.5	0.00	13.70	54.80	46.58	8.22	21.92
	Settleable and Suspended Phosphorous (Organic Phos)	8,460	6,850	0.0036	25	0.8	0.00	0.16	0.66	0.20	0.46	0.62
	Dissolved Phosphorous (inorganic Phos)	8,460	6,850	0.0014	9.59	0.3	0.00	0.32	0.00	0.00	0.00	0.32
	Settleable and Suspended Nitrogen (Organic Nitrogen)	8,460	6,850	0.0064	44	1.5	0.00	0.29	1.17	0.70	0.47	0.76
	Dissolved Nitrogen (Nitrate + Nitrite)	8,460	6,850	0.0317	217	7.2	0.00	7.23	0.01	0.00	0.01	7.24
Ammonia	8,460	6,850	0.0383	262	8.7	0.00	8.74	0.01	0.00	0.01	8.75	
May	Settleable and Total Suspended Solids (TSS)	9,400	13,700	0.3	4,110	137.0	0.00	27.40	109.60	93.16	16.44	43.84
	Settleable and Suspended Phosphorous (Organic Phos)	9,400	13,700	0.0036	49	1.6	0.00	0.33	1.32	0.39	0.92	1.25
	Dissolved Phosphorous (inorganic Phos)	9,400	13,700	0.0014	19.18	0.6	0.00	0.64	0.00	0.00	0.00	0.64
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,400	13,700	0.0064	88	2.9	0.00	0.58	2.34	1.40	0.94	1.52
	Dissolved Nitrogen (Nitrate + Nitrite)	9,400	13,700	0.0317	434	14.5	0.00	14.46	0.01	0.00	0.01	14.48
Ammonia	9,400	13,700	0.0383	525	17.5	0.00	17.48	0.01	0.00	0.01	17.49	
June 15 - June 30	Settleable and Total Suspended Solids (TSS)	0	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	0	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	0	0	0.0014	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Nitrogen (Organic Nitrogen)	0	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Dissolved Nitrogen (Nitrate + Nitrite)	0	0	0.0317	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	

	Parameter	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Ratio of Pollutant per Feed	Monthly Waste Pre-Treatment (lbs.)	Daily Waste Pre-Treatment (lbs.)	Groundwater Flowthrough (lbs.)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent (lbs.)	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Effluent (lbs.)
	Ammonia	0	0	0.0383	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
July	Settleable and Total Suspended Solids (TSS)	0	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	0	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	0	0	0.0014	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Nitrogen (Organic Nitrogen)	0	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	0	0	0.0317	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Ammonia	0	0	0.0383	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
August	Settleable and Total Suspended Solids (TSS)	0	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	0	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	0	0	0.0014	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Nitrogen (Organic Nitrogen)	0	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	0	0	0.0317	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Ammonia	0	0	0.0383	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
September	Settleable and Total Suspended Solids (TSS)	800	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	800	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	800	0	0.0014	0.00	0.0	1.31	0.00	0.00	0.00	0.00	1.31
	Settleable and Suspended Nitrogen (Organic Nitrogen)	800	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	800	0	0.0317	0	0.0	0.30	0.00	0.00	0.00	0.00	0.30
	Ammonia	800	0	0.0383	0	0.0	6.55	0.00	0.00	0.00	0.00	6.55
October	Settleable and Total Suspended Solids (TSS)	800	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	800	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	800	0	0.0014	0.00	0.0	1.31	0.00	0.00	0.00	0.00	1.31
	Settleable and Suspended Nitrogen (Organic Nitrogen)	800	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	800	0	0.0317	0	0.0	0.30	0.00	0.00	0.00	0.00	0.30
	Ammonia	800	0	0.0383	0	0.0	6.55	0.00	0.00	0.00	0.00	6.55
November	Settleable and Total Suspended Solids (TSS)	800	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	800	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	800	0	0.0014	0.00	0.0	1.31	0.00	0.00	0.00	0.00	1.31
	Settleable and Suspended Nitrogen (Organic Nitrogen)	800	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	800	0	0.0317	0	0.0	0.30	0.00	0.00	0.00	0.00	0.30
	Ammonia	800	0	0.0383	0	0.0	6.55	0.00	0.00	0.00	0.00	6.55
December	Settleable and Total Suspended Solids (TSS)	800	0	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Settleable and Suspended Phosphorous (Organic Phos)	800	0	0.0036	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Phosphorous (inorganic Phos)	800	0	0.0014	0.00	0.0	1.31	0.00	0.00	0.00	0.00	1.31
	Settleable and Suspended Nitrogen (Organic Nitrogen)	800	0	0.0064	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
	Dissolved Nitrogen (Nitrate + Nitrite)	800	0	0.0317	0	0.0	0.30	0.00	0.00	0.00	0.00	0.30
	Ammonia	800	0	0.0383	0	0.0	6.55	0.00	0.00	0.00	0.00	6.55

Table A-2. BOD pollutant load calculations per Piper et al. (1982) for currently proposed PPH operations.

Month	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Maximum Daily Feed Rate (lbs)	Pollutant Factor	Untreated Effluent (lbs/day)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Treated Effluent (lbs.)
January	4,230	1,580	53	28.3	17.91	3.58	14.33	8.60	5.73	9.31
February	5,640	3,400	113	28.3	38.54	7.71	30.83	18.50	12.33	20.04
March	8,460	4,800	160	28.30	54	10.88	43.53	26.12	17.41	28.29
April	8,460	6,850	228	28.3	77.65	15.53	62.12	37.27	24.85	40.38
May 1 - June 15	9,400	13,700	457	28.3	155.29	31.06	124.23	74.54	49.69	80.75
June 15 - 30	0	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
July	0	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
August	0	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
September	800	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
October	800	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
November	800	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00
December	800	0	0	28.3	0.00	0.00	0.00	0.00	0.00	0.00

Table A-3. Solids and nutrient pollutant load calculations per Castledine (1986) for future potential PPH operations.

	Parameter	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Ratio of Pollutant per Feed	Monthly Waste Pre-Treatment (lbs.)	Daily Waste Pre-Treatment (lbs.)	Groundwater Flowthrough (lbs.)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent (lbs.)	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Effluent (lbs.)
January	Settleable and Total Suspended Solids (TSS)	9,164	1,660	0.3	498	16.60	0.00	3.32	13.28	11.29	1.99	5.31
	Settleable and Suspended Phosphorous (Organic Phos)	9,164	1,660	0.0036	6	0.20	0.00	0.04	0.16	0.05	0.11	0.15
	Dissolved Phosphorous (inorganic Phos)	9,164	1,660	0.0014	2.32	0.08	0.41	0.08	0.00	0.00	0.00	0.49
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,164	1,660	0.0064	11	0.35	0.00	0.07	0.28	0.17	0.11	0.18
	Dissolved Nitrogen (Nitrate + Nitrite)	9,164	1,660	0.0317	53	1.75	0.09	1.75	0.00	0.00	0.00	1.85
Ammonia	9,164	1,660	0.0383	64	2.12	2.04	2.12	0.00	0.00	0.00	4.16	
February	Settleable and Total Suspended Solids (TSS)	9,929	3,690	0.3	1,107	36.90	0.00	7.38	29.52	25.09	4.43	11.81
	Settleable and Suspended Phosphorous (Organic Phos)	9,929	3,690	0.0036	13	0.44	0.00	0.09	0.35	0.11	0.25	0.34
	Dissolved Phosphorous (inorganic Phos)	9,929	3,690	0.0014	5.17	0.17	1.31	0.17	0.00	0.00	0.00	1.48
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,929	3,690	0.0064	24	0.79	0.00	0.16	0.63	0.38	0.25	0.41
	Dissolved Nitrogen (Nitrate + Nitrite)	9,929	3,690	0.0317	117	3.90	0.30	3.90	0.00	0.00	0.00	4.20
Ammonia	9,929	3,690	0.0383	141	4.71	6.55	4.71	0.00	0.00	0.00	11.26	
March	Settleable and Total Suspended Solids (TSS)	9,929	5,940	0.3	1,782	59.4	0.00	11.88	47.52	40.39	7.13	19.01
	Settleable and Suspended Phosphorous (Organic Phos)	9,929	5,940	0.0036	21	0.7	0.00	0.14	0.57	0.17	0.40	0.54
	Dissolved Phosphorous (inorganic Phos)	9,929	5,940	0.0014	8.32	0.3	1.31	0.28	0.00	0.00	0.00	1.58
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,929	5,940	0.0064	38	1.3	0.00	0.25	1.01	0.61	0.41	0.66
	Dissolved Nitrogen (Nitrate + Nitrite)	9,929	5,940	0.0317	188	6.3	0.30	6.27	0.01	0.00	0.01	6.58
Ammonia	9,929	5,940	0.0383	228	7.6	6.55	7.58	0.01	0.00	0.01	14.13	
April	Settleable and Total Suspended Solids (TSS)	9,929	9,130	0.3	2,739	91.3	0.00	18.26	73.04	62.08	10.96	29.22
	Settleable and Suspended Phosphorous (Organic Phos)	9,929	9,130	0.0036	33	1.1	0.00	0.22	0.88	0.26	0.61	0.83
	Dissolved Phosphorous (inorganic Phos)	9,929	9,130	0.0014	12.78	0.4	1.31	0.43	0.00	0.00	0.00	1.73
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,929	9,130	0.0064	58	1.9	0.00	0.39	1.56	0.93	0.62	1.01
	Dissolved Nitrogen (Nitrate + Nitrite)	9,929	9,130	0.0317	289	9.6	0.30	9.64	0.01	0.00	0.01	9.95
Ammonia	9,929	9,130	0.0383	350	11.7	6.55	11.65	0.01	0.00	0.01	18.21	
May	Settleable and Total Suspended Solids (TSS)	9,000	9,390	0.3	2,817	93.9	0.00	18.78	75.12	63.85	11.27	30.05
	Settleable and Suspended Phosphorous (Organic Phos)	9,000	9,390	0.0036	34	1.1	0.00	0.23	0.90	0.27	0.63	0.86
	Dissolved Phosphorous (inorganic Phos)	9,000	9,390	0.0014	13.15	0.4	0.00	0.44	0.00	0.00	0.00	0.44
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,000	9,390	0.0064	60	2.0	0.00	0.40	1.60	0.96	0.64	1.04
	Dissolved Nitrogen (Nitrate + Nitrite)	9,000	9,390	0.0317	298	9.9	0.00	9.91	0.01	0.00	0.01	9.92
Ammonia	9,000	9,390	0.0383	360	12.0	0.00	11.98	0.01	0.00	0.01	11.99	
June	Settleable and Total Suspended Solids (TSS)	9,000	875	0.3	263	8.8	0.00	1.75	7.00	5.95	1.05	2.80
	Settleable and Suspended Phosphorous (Organic Phos)	9,000	875	0.0036	3	0.1	0.00	0.02	0.08	0.03	0.06	0.08
	Dissolved Phosphorous (inorganic Phos)	9,000	875	0.0014	1.23	0.0	0.00	0.04	0.00	0.00	0.00	0.04
	Settleable and Suspended Nitrogen (Organic Nitrogen)	9,000	875	0.0064	6	0.2	0.00	0.04	0.15	0.09	0.06	0.10
Dissolved Nitrogen (Nitrate + Nitrite)	9,000	875	0.0317	28	0.9	0.00	0.92	0.00	0.00	0.00	0.92	

	Parameter	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Ratio of Pollutant per Feed	Monthly Waste Pre-Treatment (lbs.)	Daily Waste Pre-Treatment (lbs.)	Groundwater Flowthrough (lbs.)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent (lbs.)	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Effluent (lbs.)
	Ammonia	9,000	875	0.0383	34	1.1	0.00	1.12	0.00	0.00	0.00	1.12
July	Settleable and Total Suspended Solids (TSS)	1,350	1,393	0.3	418	13.9	0.00	2.79	11.14	9.47	1.67	4.46
	Settleable and Suspended Phosphorous (Organic Phos)	1,350	1,393	0.0036	5	0.2	0.00	0.03	0.13	0.04	0.09	0.13
	Dissolved Phosphorous (inorganic Phos)	1,350	1,393	0.0014	1.95	0.1	1.31	0.06	0.00	0.00	0.00	1.37
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,350	1,393	0.0064	9	0.3	0.00	0.06	0.24	0.14	0.10	0.15
	Dissolved Nitrogen (Nitrate + Nitrite)	1,350	1,393	0.0317	44	1.5	0.30	1.46	0.01	0.00	0.01	1.77
	Ammonia	1,350	1,393	0.0383	53	1.8	6.55	1.77	0.01	0.00	0.01	8.33
August	Settleable and Total Suspended Solids (TSS)	1,350	1,223	0.3	367	12.2	0.00	2.45	9.78	8.32	1.47	3.91
	Settleable and Suspended Phosphorous (Organic Phos)	1,350	1,223	0.0036	4	0.1	0.00	0.03	0.12	0.04	0.08	0.11
	Dissolved Phosphorous (inorganic Phos)	1,350	1,223	0.0014	1.71	0.1	1.31	0.06	0.00	0.00	0.00	1.36
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,350	1,223	0.0064	8	0.3	0.00	0.05	0.21	0.13	0.08	0.14
	Dissolved Nitrogen (Nitrate + Nitrite)	1,350	1,223	0.0317	39	1.3	0.30	1.28	0.01	0.00	0.01	1.59
	Ammonia	1,350	1,223	0.0383	47	1.6	6.55	1.55	0.01	0.00	0.01	8.11
September	Settleable and Total Suspended Solids (TSS)	1,350	1,690	0.3	507	16.9	0.00	3.38	13.52	11.49	2.03	5.41
	Settleable and Suspended Phosphorous (Organic Phos)	1,350	1,690	0.0036	6	0.2	0.00	0.04	0.16	0.05	0.11	0.15
	Dissolved Phosphorous (inorganic Phos)	1,350	1,690	0.0014	2.37	0.1	1.31	0.08	0.00	0.00	0.00	1.39
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,350	1,690	0.0064	11	0.4	0.00	0.07	0.29	0.17	0.12	0.19
	Dissolved Nitrogen (Nitrate + Nitrite)	1,350	1,690	0.0317	54	1.8	0.30	1.78	0.01	0.00	0.01	2.09
	Ammonia	1,350	1,690	0.0383	65	2.2	6.55	2.14	0.01	0.00	0.01	8.71
October	Settleable and Total Suspended Solids (TSS)	1,850	1,360	0.3	408	13.6	0.00	2.72	10.88	9.25	1.63	4.35
	Settleable and Suspended Phosphorous (Organic Phos)	1,850	1,360	0.0036	5	0.2	0.00	0.03	0.13	0.04	0.09	0.12
	Dissolved Phosphorous (inorganic Phos)	1,850	1,360	0.0014	1.90	0.1	1.31	0.06	0.00	0.00	0.00	1.37
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,850	1,360	0.0064	9	0.3	0.00	0.06	0.23	0.14	0.09	0.15
	Dissolved Nitrogen (Nitrate + Nitrite)	1,850	1,360	0.0317	43	1.4	0.30	1.43	0.01	0.00	0.01	1.74
	Ammonia	1,850	1,360	0.0383	52	1.7	6.55	1.73	0.01	0.00	0.01	8.29
November	Settleable and Total Suspended Solids (TSS)	1,850	1,750	0.3	525	17.5	0.00	3.50	14.00	11.90	2.10	5.60
	Settleable and Suspended Phosphorous (Organic Phos)	1,850	1,750	0.0036	6	0.2	0.00	0.04	0.17	0.05	0.12	0.16
	Dissolved Phosphorous (inorganic Phos)	1,850	1,750	0.0014	2.45	0.1	1.31	0.08	0.00	0.00	0.00	1.39
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,850	1,750	0.0064	11	0.4	0.00	0.07	0.30	0.18	0.12	0.19
	Dissolved Nitrogen (Nitrate + Nitrite)	1,850	1,750	0.0317	55	1.8	0.30	1.84	0.01	0.00	0.01	2.15
	Ammonia	1,850	1,750	0.0383	67	2.2	6.55	2.22	0.01	0.00	0.01	8.78
December	Settleable and Total Suspended Solids (TSS)	1,850	2,925	0.3	878	29.3	0.00	5.85	23.40	19.89	3.51	9.36
	Settleable and Suspended Phosphorous (Organic Phos)	1,850	2,925	0.0036	11	0.4	0.00	0.07	0.28	0.08	0.20	0.27
	Dissolved Phosphorous (inorganic Phos)	1,850	2,925	0.0014	4.10	0.1	1.31	0.14	0.00	0.00	0.00	1.44
	Settleable and Suspended Nitrogen (Organic Nitrogen)	1,850	2,925	0.0064	19	0.6	0.00	0.12	0.50	0.30	0.20	0.32
	Dissolved Nitrogen (Nitrate + Nitrite)	1,850	2,925	0.0317	93	3.1	0.30	3.08	0.01	0.00	0.01	3.39
	Ammonia	1,850	2,925	0.0383	112	3.7	6.55	3.72	0.02	0.00	0.02	10.28

Table A-4. BOD pollutant load calculations per Piper et al. (1982) for future potential PPH operations.

	Flow (gpm)	Maximum Monthly Feed Rate (lbs)	Maximum Daily Feed Rate (lbs)	Pollutant Factor	Untreated Effluent (lbs/day)	Rearing Pond Flowthrough Effluent (lbs.)	PA Pond Influent	PA Pond Removal (lbs.)	PA Pond Effluent (lbs.)	Total Treated Effluent (lbs.)
January	9,164	1,660	55	28.3	18.82	3.76	15.05	9.03	6.02	9.78
February	9,929	3,690	123	28.3	41.83	8.37	33.46	20.08	13.38	21.75
March	9,929	5,940	198	28.30	67	13.47	53.86	32.32	21.55	35.01
April	9,929	9,130	304	28.3	103.49	20.70	82.79	49.68	33.12	53.81
May	9,000	9,390	313	28.3	106.44	21.29	85.15	51.09	34.06	55.35
June	9,000	875	29	28.3	9.92	1.98	7.93	4.76	3.17	5.16
July	1,350	1,393	46	28.3	15.79	3.16	12.63	7.58	5.05	8.21
August	1,350	1,223	41	28.3	13.86	2.77	11.09	6.65	4.44	7.21
September	1,350	1,690	56	28.3	19.16	3.83	15.33	9.20	6.13	9.96
October	1,850	1,360	45	28.3	15.42	3.08	12.33	7.40	4.93	8.02
November	1,850	1,750	58	28.3	19.84	3.97	15.87	9.52	6.35	10.32
December	1,850	2,925	98	28.3	33.16	6.63	26.52	15.91	10.61	17.24